Performance Evaluation Report #29

Des Moines TCE Site (DICO)
200 SW 16th Street
Des Moines, Iowa

Project No: 15-361

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1.0 Introduction

The Des Moines TCE site, also known as DICO, continues active treatment of a chlorinated solvent contaminant plume by a pump and treat (P&T) system with a permitted discharge to the Raccoon River. This groundwater recovery system has operated since 1987 with the specific purpose to eliminate off-site migration of trichloroethylene and its degradation products, toward the infiltration gallery operated by the Des Moines Water Works, the water supplier for the City of Des Moines. Through an analysis of the quarterly water level data, which includes most if not all monitoring wells, piezometers, and manholes, in addition to the operating recovery wells, it can be shown the recovery wells have effectively limited the off-site migration of the dissolved phase constituents, so much so that it has become practically and financially non-feasible to continue this pace of minimal contaminant mass recovery and increasing operating costs hence alternative remedial technologies are necessary to avoid the costs per gallon recovery of TCE.

Groundwater monitoring to assess the performance of the groundwater recovery system has been conducted over the past 27 years. The system operates at greater than 95% efficiency with respect to the permit limits. Overall, 1,2-dichloroethylene (CIS & TRANS); vinyl chloride; 1,1-dichloroethylene; and trichloroethylene concentrations remain generally stable.

To assess any alleged migration of contaminants toward the Des Moines and Raccoon Rivers, respectively, and in compliance with DICO's National Pollutant Discharge Elimination System (NPDES) permit, surface water grab samples, influent and effluent samples from the groundwater extraction system are collected. Results of this sampling continue to show no impacts to surface water, which has been a primary benchmark used to determine success of the pump and treat system over time. But, since total contaminant mass available for recovery has continued to decline over time, this metric no longer supplies meaningful information unless the location of the plume is pinpointed. Dico will solicit USEPA assistance in this determination via the available data of approximately 30 years of system operation.

This report is intended to document and reflect the operation and performance of the groundwater extraction system historically and over the past year of operation with supporting figures and tables and in support of DICO claims that the system has been very effective in the past and reached a stage where it can be replaced with a less "Energy Involved" system that can be as effective to eventually attain TCE at or below MCL values.

2.0 System Performance

2.1 Introduction

The following sections summarize the operation of the recovery wells and the air stripper tower, provide an analysis of the groundwater capture zone inferred from water level data, and discuss the results from the semi-annual groundwater and surface water sampling which is conducted on or about April and October of each year. These discussions will show the overall performance of the pump and treat system, specifically to evaluate the system's efficiency in removing the traces of chlorinated contaminants and prevent their migration. Figure 1 shows the location of the air stripping tower in relation to all recovery wells, monitoring wells, piezometers, and the Des Moines Water Works infiltration gallery.

2.2 Recovery Wells

A total of seven (7) recovery wells (ERW-3 through ERW-9) were installed in the fall of 1987. The purpose of which was to extract contaminated groundwater to eliminate migration of any chlorinated residues towards the Des Moines Water Works infiltration galleries. In lieu of significant iron scaling, ERW-9 was shut down in 1988. ERW-3 and ERW-4 were taken off line in March 2003 and ERW-8 was shut down in November 2003. As stated in the Performance Evaluation Report No. 27 issued by Environmental Management and Engineering, Inc. (EME), approval by USEPA was granted on or about 2004 to shut down these recovery wells based on negligible recovery of groundwater that could otherwise be accomplished pumping from ERW-5, ERW-6, and ERW-7.

During 2014, ERW-5, ERW-6, and ERW-7, collectively pumped at an average rate of about 160 gallons/minute, producing an approximate recovery of 84 million gallons of water. Throughout the same time, static pressures in-line with the blower ranged from 1.75 to 2.40 inches of water, with measured air flows of 9,500 or 10,000 cubic feet per minute (cfm).

Water level data has been collected from each recovery well since 1987. Figure 2 is a hydrograph of the recovery wells ERW-5, ERW-6, and ERW-7 from the last 27 years of operation. Figure 3 is a hydrograph that includes groundwater elevation data from the three (3) recovery wells during 2014 in relation to the Raccoon River stage. All data, including the recovery wells combined with all other monitoring wells and piezometers is summarized on Table 1. The raw data from all monthly water level measurements collected during 2014 is provided in Appendix A. All river stage measurements from the Raccoon River at Fleur Drive were obtained from the U.S. Army Corps of Engineers website: http://rivergages.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=DEMI4&fid=DEMI4&dt=S.

2.3 Air Stripper

Groundwater is extracted from each of the three (3) recovery wells and is directed towards the stripping tower which uses high air to water ratios; volatiles are stripped from the water and discharged directly to the atmosphere through DICO's Air Permit. Treated water is discharged to the Raccoon River in compliance with the National Pollutant Discharge Elimination System (NPDES) permit. System effectiveness as documented by the mass of contaminants removed from groundwater using the air stripper is conducted by collection of influent and effluent groundwater samples in accordance with the NPDES permit # 77-27-1-27. These influent and effluent groundwater samples are analyzed for the seven (7) target chlorinated VOCs: chloroform; 1,1-dichloroethylene (1,1-DCE); 1,2-dichloroethylene (1,2-DCE, CIS & TRANS); 1,2-dichloroethane (1,2-DCA); 1,1,1-trichloroethane (1,1,1-TCA); trichloroethylene (TCE); and vinyl chloride. Figure 4 plots influent VOC concentrations since the system began operation to present, while Figure 5 shows influent concentration trends within the most recent ten (10) years. As depicted on Figure 5, a relatively constant or narrow range in recovered 1,2-DCE and vinyl chloride concentrations exists during the 2014 monitoring period, in addition to low concentrations of 1,2-DCE (CIS & TRANS) and vinyl chloride for the most recent ten (10) years of continuous monitoring. TCE concentrations during the most recent ten (10) years of monitoring varied between about 1,400 µg/L to less than 100 µg/L; and for the period of 2014, ranged between about 800 µg/L to 220 µg/L. The contaminant concentrations trends are generally consistent with those observed in 2013, and indicate the recovery system has achieved its maximum potential with annual costs to operate exceeding any benefit signifying the most appropriate time to initiate natural attenuation.

Table 2 shows the air stripper continues to effectively remove remaining traces of dissolved phase contaminants at consistent efficiencies greater than 95%. Figure 6 illustrates cumulative air stripper efficiency for TCE removal since 1987. Figure 7 shows static pressures for the period 1988 to current as measured in units of inches of water. Air flows are measured weekly, same as static pressure, also for the period 1988 to current. Figure 8 shows air flow pressures throughout 2014, which are expressed in units of cubic feet per minute (cfm). These proved to be relatively constant. Optimum system performance occurs at static pressures in the range of about 3.5 inches of water and air flow pressures around 7,000 cubic feet per minute (cfm) or greater, thus, maximizing the air to water ratios. More recent measurements have shown operating pressures between 1-2 inches of water and flows around 9,500 cfm.

In addition to contaminant hydrogeology, general water quality pre-air and post-air stripper is also measured by testing for pH and total iron. These results are summarized in Table 3. It should be noted the packing media was replaced between February 18 and 28, 2014, at a cost of $65,000.00. The spent material was profiled and then disposed at a permitted non-hazardous landfill after testing (please see March 11, 2014, monthly cover letter for additional information).

Since inception of the pump and treat system in 1987 through 2014, it appears that more than 3,500 gallons of TCE product have been recovered. This information is provided on Figure 9. For total contaminant volume recovered over the period 1987 to 2014, which includes all analytes, roughly 4,150 gallons has been removed from the groundwater system. Of this total, only about 40 gallons of contaminants was recovered over the period 2013 to 2014, which amounts to only 1%, as presented on Figure 10, clearly supporting the natural attenuation requests made by DICO over the past 2-3 years.

3.0 Pump and Treat Groundwater Capture Zone Analysis

Based on data on the east side of Raccoon River, the pump and treat system is effectively reducing, and/or gradually eliminating, the off-site migration of contaminants towards the DMWW's north infiltration gallery. For instance, hydraulic head measurements collected quarterly during 2014 suggest a groundwater capture width of roughly 100 feet. By having the recovery wells located and screened in the source area, would necessarily mean the off-site migration of contaminants are effectively reduced or altogether eliminated.

These recovery wells include ERW-5, ERW-6, and ERW-7, where artificial gradients in response to pumping induce recharge from the Raccoon River (or opposite the infiltration gallery) to the alluvial aquifer. Evidence for this can be seen on Figure 11, which depicts groundwater flow conditions on a quarterly basis throughout 2014. Also on the east side of the river, north of the recovery wells ERW-5, ERW-6, and ERW-7, a consistent groundwater low in the area of piezometer P-2 occurs unrelated to pumping. The reason for this occurrence is unclear but is suspected to be the result of engineered storm water drainage, e.g., wet wells or retention basins, since P-2 exists near or within a parking area.

For areas inside the Raccoon River meander, the effect of spillway flash board acts to increase hydrostatic pressures of the river relative to groundwater. This means the river loses water to the groundwater system. By losing water to the groundwater system, would effectively mean an established hydraulic barrier exists, eliminating the likelihood of contaminants migrating toward the river while the spillway remains into the foreseeable future.

4.0 Groundwater Quality

Groundwater samples are collected semi-annually, in or about April for an abbreviated list of VOCs, and again in or about October for the same VOCs plus several others. This has occurred since the system began operating in 1987. The abbreviated list includes: trichloroethylene; 1,2-Dichloroethane; 1,2-dichloroethylene (cis+trans); vinyl chloride; 1,1-dichloroethylene; chloroform; and 1,1,1-trichloroethane. In April 2014, results of this sampling showed the occurrence of TCE at ERW-5 and ERW-6 with lower levels at NW-22. Table 4 provides the analytical summary of all samples collected for the April 2014 event. Figures 12 and 13 are isopleths of TCE and 1,2-DCE (cis+trans) concentrations, respectively, exceeding Maximum Contaminant Levels (MCLs)..

For the samples collected in October 2014, the maximum TCE concentration occurs at ERW-6 and is reported as 240 µg/L. The wells NW-2, NW-23, EW-5, and EW-6 define the plume on site. For 1,2-DCE (cis+trans), the maximum measured concentrations occur at ERW-7 of 400 µg/L. This plume is also defined on site; ERW-7 is the only location showing minimal detection for 1,2-DCE. Table 5 provides the analytical summary of all samples collected for the October 2014 event. Figures 14 and 15 are isopleths of TCE and 1,2-DCE (cis+trans) concentrations, respectively.

5.0 Des Moines Water Works Infiltration Gallery

According to the Performance Evaluation Report #27 and available public records, the Des Moines Water Works discontinued operating the North Gallery on or about 1988. This gallery is located inside the Raccoon River meander, opposite the DICO property, between the well NW-9 and piezometer P-4. The South Gallery is located approximately 1,800 feet southwest of the North Gallery. Sampling for this gallery occurs through two (2) manholes: MH-1N and MH-1S; however, samples from MH-1S were not collected during 2014 due to insufficient water. Results from sampling MH-1N continue to show minimal concentrations for the parameters of concern.

6.0 Surface Water Quality

Surface water samples were collected from the Raccoon River and Des Moines River in April and October 2014. These samples were analyzed for the following: trichloroethylene; 1,2-Dichloroethane; 1,2-dichloroethylene (cis+trans); vinyl chloride; 1,1-dichloroethylene; chloroform; and 1,1,1-trichloroethane. None of these constituents were detected at either location.

7.0 Conclusions

Based on the results of the semi-annual performance groundwater sampling in combination with observation and monitoring (O&M) data from the air stripper, the pump and treat (P&T) system has functioned consistent with its intended purpose. The conclusions drawn in this section and the proposed alternatives are based on calculations conducted applying an average flow rate of 300 gallons/minute, multiplied by the maximum measured TCE concentration (over past ten years) of 2,300 µg/L, results in total mass discharged of about 8 pounds/day, well below the calculated maximum per the NPDES Permit (#7727127) of 32.6 pounds/day and since the removal of the product ($ per gallon) shows a ridiculously high cost ($thousands/ gal TCE recovered) hence the need for alternative new technologies becomes necessary.

The influent TCE concentrations remain higher than the MCL and hence system operation remains necessary until other technologies such as Bacterial Bio-degradation Remediation technology or if the site is acquired for development after proper discussions and approval of the Superfund Division/ USEPA Region VII; a more scenic aeriated pond (Oxidative Aeriation) design can be an ideal replacement for the current Air Stripper Tower System. Dico will solicit USEPA to conduct some feasibility studies for alternative long term, more economical alternatives in lieu of the current discussions with USEPA and the City of Des Moines regarding the future of the site and its development potential.

Figures

Figure 1

Site Map

Figure 2

Hydrograph of Operating Recovery Wells

(1987-2014)

Figure 3

Hydrograph of Operating Recovery Wells and Raccoon River Stage (2014)

Figure 4

Air Stripper Influent Concentrations
(1987-2014)

Figure 5

Air Stripper Influent Concentrations
(2004-2014)

Figure 6

Air Stripper Efficiency
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Air Stripper Static Pressure
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Equivalent Gallons Recovered
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Figure 10

Equivalent Gallons Recovered
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(April 2014)

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1,2-DCE Concentrations in Groundwater (April 2014)

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TCE Concentrations in Groundwater
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Figure 15

1,2-DCE Concentrations in Groundwater (October 2014)

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Groundwater Elevation Measurements (2014)

Table 2

Summary of Air Stripper Efficiency
(2014)

Table 3

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Table 4

Summary of Groundwater and Surface Water Quality Data (April 2014)

Table 5

Summary of Groundwater and Surface Water Quality Data (October 2014)

Appendices

Appendix A

Monthly Progress Reports

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February 2014

March 2014

April 2014

May 2014

June 2014

July 2014

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November 2014

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